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SOLAR HEATING AND COOLING  
TECHNICAL DATA AND SYSTEMS ANALYSIS  
PRESENTATION CHARTS

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# Center for Environmental and Energy Studies

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**The University  
Of Alabama  
In Huntsville**

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(NASA-CR-150012) SOLAR HEATING AND COOLING N76-33623  
TECHNICAL DATA AND SYSTEMS ANALYSIS Interim  
Status Report, Sep. 1975 - Aug. 1976  
(Alabama Univ., Huntsville.) 38 p HC \$4.00 Unclass  
CSCI 10A G3/44 05751

SEPTEMBER 1976



SOLAR HEATING AND COOLING  
TECHNICAL DATA AND SYSTEMS ANALYSIS

PRESENTATION CHARTS  
(Briefing to NASA September 20, 1976)

CONTRACT NAS8-31293

Submitted to

National Aeronautics & Space Administration  
Marshall Space Flight Center, Alabama

(Summary for Period September 1975 - August 1976)

A handwritten signature in dark ink, appearing to read 'D. L. Christensen', is written over a horizontal line.

D. L. Christensen  
Principal Investigator

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE  
CENTER FOR ENVIRONMENTAL AND ENERGY STUDIES  
HUNTSVILLE, ALABAMA

SEPTEMBER 1976

## INTRODUCTION

This presentation was given to the NASA Marshall Space Flight Center on September 20, 1976 as part of an interim status report on Contract NAS8-31293. In addition, certain overall considerations concerning the contract effort were presented by UAH. These considerations included systems planning, methodology and procedures which might be applied to the current program. Projected activities including computer modeling, program management systems and other tasks involving the UAH Center for Environmental and Energy Studies were outlined at this time.

Attendees at the briefing were:

### UAH Attendees

D. L. Christensen  
E. A. Carter  
J. P. Goddard  
K. E. Johnson  
W. L. Reid  
B. J. Schroer  
O. Tabor  
L. A. Whinnery

### NASA-MSFC Attendees

S. A. Hill  
A. G. Kromis  
R. L. Middleton  
J. M. Price  
O. L. Smith



SOLAR HEATING AND COOLING  
TECHNICAL DATA AND SYSTEMS ANALYSIS

RESEARCH STUDY FOR NASA-MSFC  
CONTRACT NUMBER NAS8-31293  
STARTING DATE - OCTOBER 1974

STATUS REPORT  
THROUGH SEPTEMBER 20, 1976

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE  
CENTER FOR ENVIRONMENTAL AND ENERGY STUDIES

## PRESENTATION OUTLINE

INTRODUCTION AND OVERVIEW - OBJECTIVES, FINANCIAL, ETC.

TASK 1 - COMPUTERIZED DATA BASE (MIRADS)

TASK 2 - MANAGEMENT AND EDUCATIONAL MATERIALS

TASK 3 - SOLAR RADIATION INSTRUMENT CATALOG

TASK 4 - SOLAR RADIATION SITE DATA

TASK 5 - COMMERCIAL SITE TECHNICAL REVIEWS (ASHRAE)

### OTHER TASKS

- SOLAR HEATING MODULE - DESIGN & SUPPORT
- AIA RESEARCH CORP. - TECHNICAL SUPPORT
- PROGRAM MANAGEMENT SUPPORT

### SUMMARY

## OVERALL PROGRAM OBJECTIVES

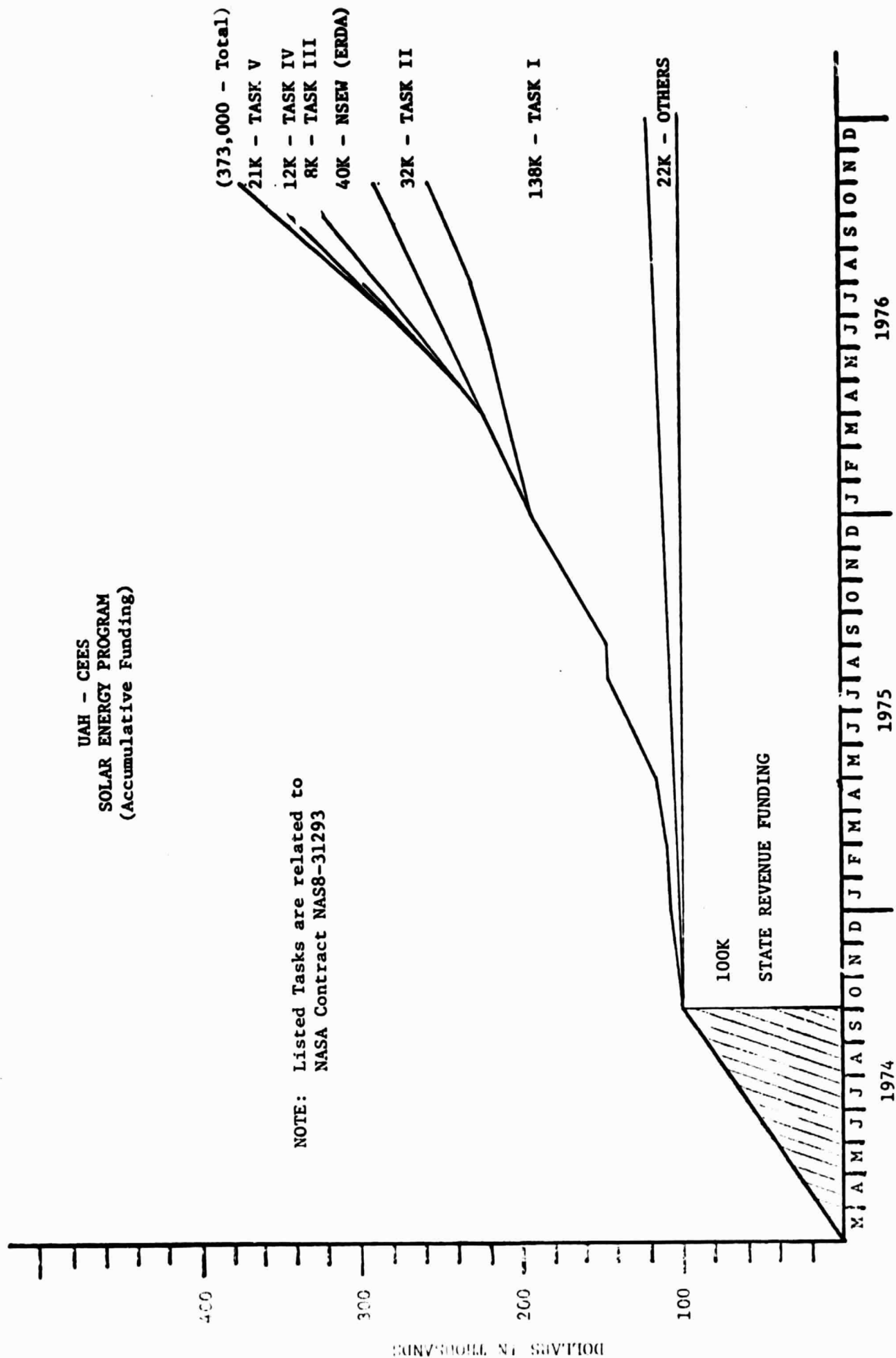
- PROVIDE RESEARCH SUPPORT TO MSFC SOLAR TASK TEAM
- DETERMINE STATE-OF-ART IN SOLAR ENERGY HEATING AND COOLING
- IDENTIFY SOURCES OF RELATED INFORMATION AND ACQUIRE NEEDED DATA
- DEVELOP DATA PACKAGES IN SELECTED AREAS
- PROVIDE FORMATS AND INPUTS FOR THE SYSTEMS ANALYSIS DATA BASE (NASA-MSFC)
  - ARCHITECTURAL                      ○ CLIMATIC
  - SITE CONDITIONS                      ○ EQUIPMENT
  - MATERIALS                      ○ ECONOMIC

## CONTRACT ACTIVITIES

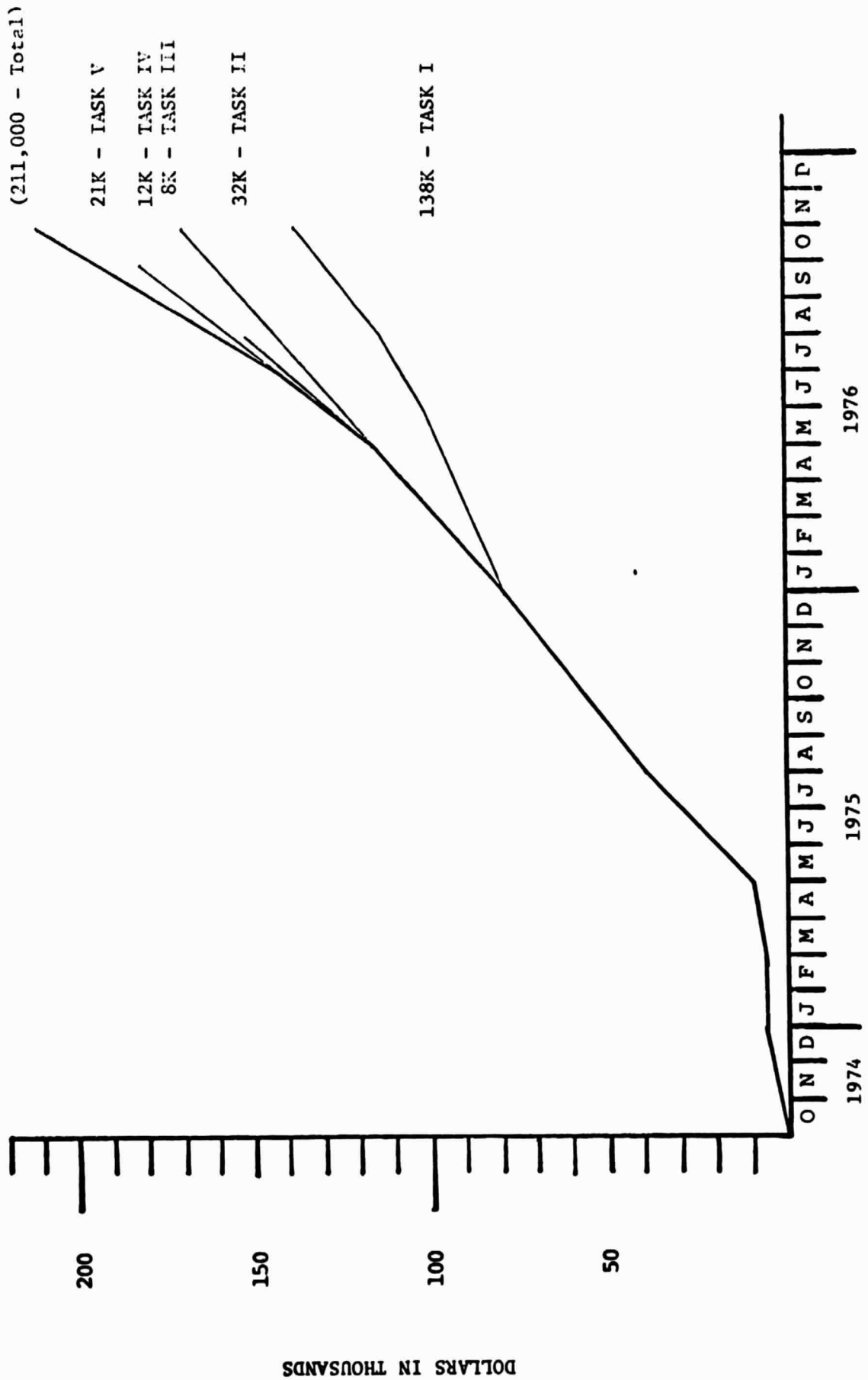
- DEVELOPED PRESENTATION MATERIAL (DATA PACKAGES, SLIDES, CHARTS, VISUALS)
- SEMINARS AND CONSULTANT SUPPORT (LÖF, DUFFIE, YELLOTT, ASHRAE)
- DEVELOPED BIBLIOGRAPHIES AND SOURCE MATERIALS
  - MATERIALS AND COATINGS                      ○ SOLAR COLLECTORS
  - SOLAR WATER HEATERS                      ○ SOLAR PROJECTS
  - SYSTEMS ANALYSIS COMPUTER MODELS
- DEVELOPED AND UPDATED DETAILED MIRADS COMPUTER FORMATS FOR PRIMARY DATA PARAMETERS (NATIONWIDE) AND ENTERED DATA
  - CLIMATIC                      ○ HEATING AND COOLING EQUIPMENT
  - ARCHITECTURAL                      ○ THERMAL LOADS
  - SITE (TOPOGRAPHY)                      ○ ECONOMIC (ENERGY AND GEOGRAPHIC)
- IDENTIFIED AND CONTACTED DATA SOURCES IN EACH OF ABOVE AREAS
- IDENTIFIED AND CONTACTED SOLAR RADIATION DATA STATIONS AND INSTRUMENTS

UAH - CEES  
SOLAR ENERGY PROGRAM  
(Accumulative Funding)

NOTE: Listed Tasks are related to  
NASA Contract NAS8-31293



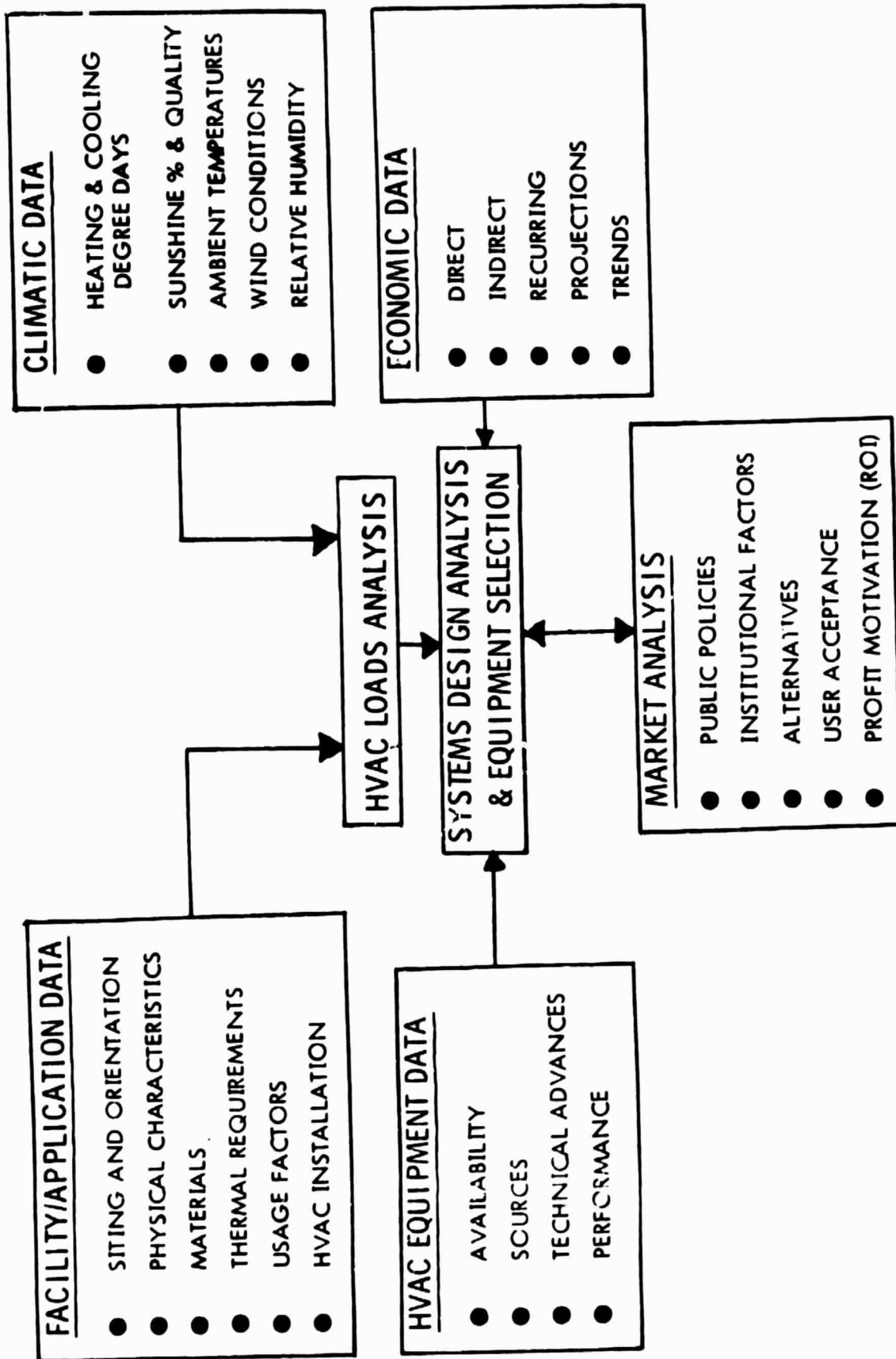
UAH - CEES  
 NASA MSFC CONTRACT NAS 8-31293  
 (Accumulative Funding)



## TASK 1 OBJECTIVES

- COLLECT CLIMATIC AND ENVIRONMENTAL DATA FOR USE IN SIMULATIONS AND EVALUATIONS OF SHAC SYSTEMS
- ACQUIRE ARCHITECTURAL DATA TO DESCRIBE TYPICAL BUILDINGS FOR SYSTEMS ANALYSIS PURPOSES
- COLLECT DATA ON THE THERMAL PROPERTIES OF VARIOUS MATERIALS FOR THERMAL ANALYSES OF BUILDINGS
- ACQUIRE DATA ON CONVENTIONAL AND SHAC SYSTEMS AND COMPONENTS FOR PERFORMANCE EVALUATION
- ACQUIRE ECONOMICS DATA FOR SPECIFIC GEOGRAPHIC AREAS FOR ANALYSIS OF ECONOMIC INFLUENCES ON INPUT AND OPERATION OF SHAC SYSTEMS IN THE U.S.

## DATA REQUIREMENTS



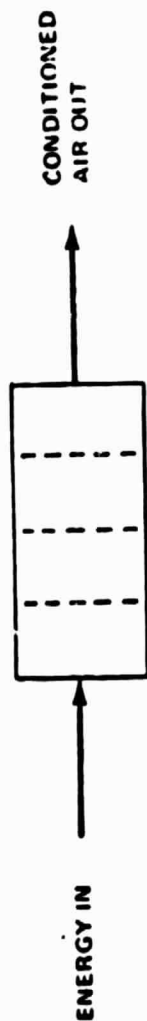


## TASK 1 ACCOMPLISHMENTS

- 79 REELS OF SOLAR RADIATION AND WEATHER DATA HAVE BEEN COLLECTED,  
AS WELL AS HARD COPY
- BLUEPRINTS OF "STANDARD" HOMES AND COMMERCIAL STRUCTURES HAVE BEEN  
ACQUIRED FOR ANALYSIS
- A SURVEY OF ALL U.S. MANUFACTURERS OF CONVENTIONAL AND SHAC EQUIPMENT  
HAS BEEN COMPLETED (CONTINUALLY REVIEWED AND UPDATED)
- DETAILED ECONOMIC DATA (1950 - 75) HAS BEEN GATHERED AND ENTERED INTO  
THE NASA DATA BASE (PRIMARILY FROM STATISTICAL ABSTRACTS)
- A CARD CATALOGUE SYSTEM HAS BEEN DEVELOPED FOR ALL DATA SOURCES
- OVER 26,000 FORMAT SHEETS HAVE BEEN ENTERED INTO THE NASA DATA BASE  
SINCE SEPTEMBER 1975.

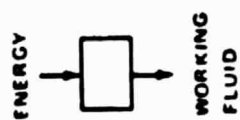
# EQUIPMENT DATA BREAKDOWN

## SYSTEM



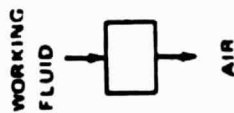
## SUBSYSTEMS

### CONVERTER



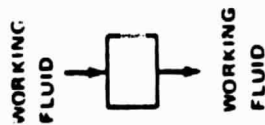
COMPONENTS  
LIST

### HEAT EXCHANGER



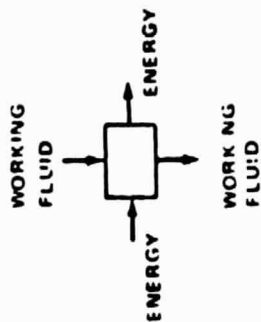
COMPONENTS  
LIST

### STORAGE



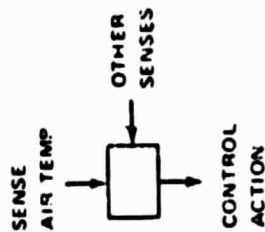
COMPONENTS  
LIST

### CHILLER



COMPONENTS  
LIST

### CONTROL



COMPONENTS  
LIST

## TASK 1 RECOMMENDATIONS

- COMPILE USER'S GUIDE TO DATA BASE (BROCHURE STYLE) TO ENCOURAGE BROADER AWARENESS AND UTILIZATION
- CARRY OUT USER SURVEY TO DETERMINE WHAT USERS NEED
- BASED ON ABOVE, PREPARE A PRIORITY LISTING OF PERTINENT PARAMETERS DESIRABLE FOR SHAC

### SYSTEMS ANALYSIS PROCEDURES

- LOCATE A REMOTE TERMINAL AT UAH FOR IMPROVED ACCESSIBILITY TO THE DATA BASE MATERIAL
- SURVEY ALL COMPUTER MODELS FOR UPDATING MIRADS
- SET UP COMPUTER FORMAT FOR ENTRY OF VARIOUS SOLAR PROJECTS NOW BEING COMPILED IN

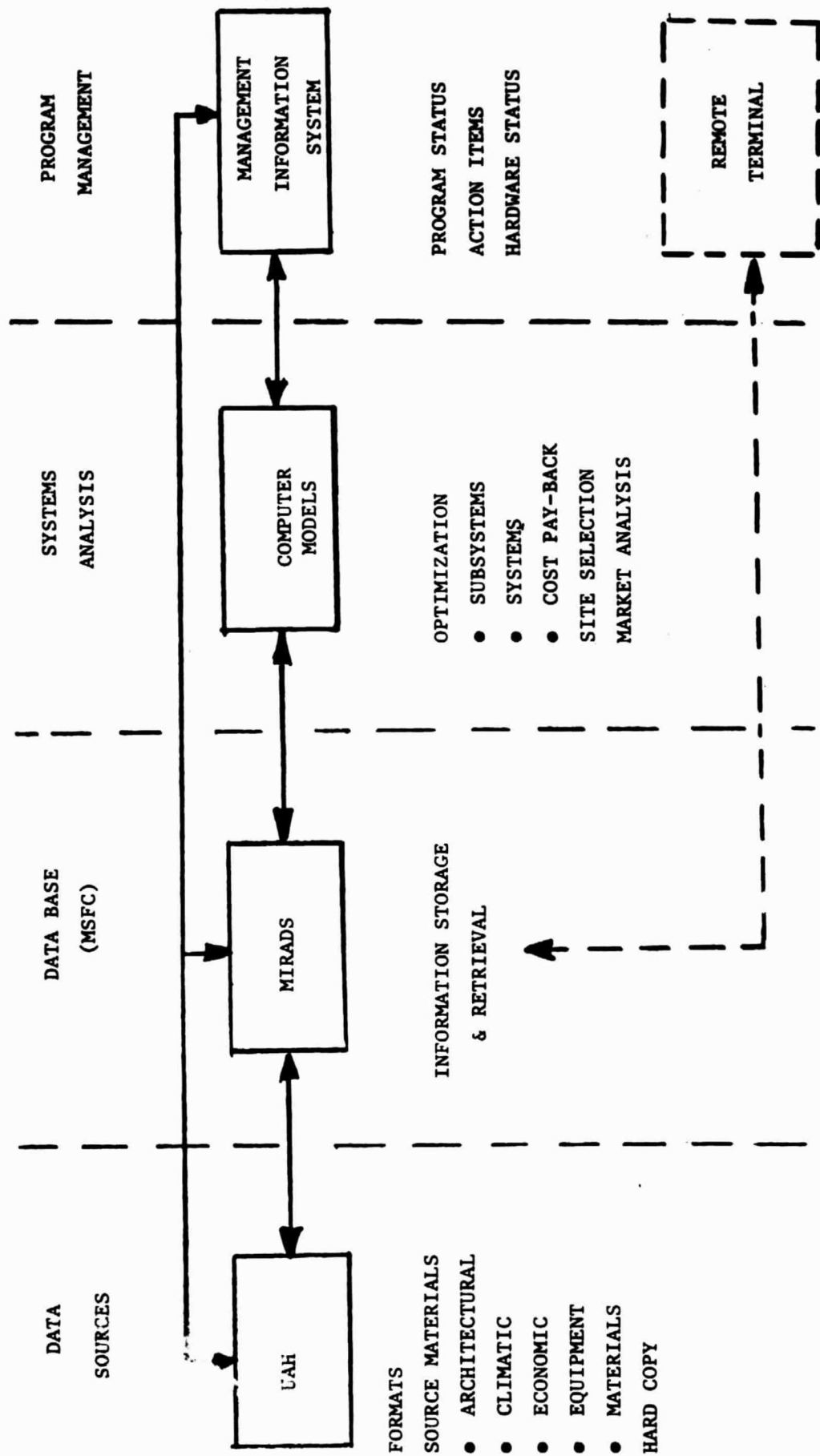
### HARD COPY

- PUT RADIATION INSTRUMENTATION DATA FROM TASK 3 INTO THE EQUIPMENT LISTING
- SURVEY ALL SOLAR ACTIVITIES, STATE BY STATE, INCLUDING THE SITE ACTIVITY, ETC.,

### FOR QUICK REVIEW OF REGIONAL ACTIVITY

- FORMAT SHAC MARKET PENETRATION PROJECTIONS FOR INCLUSION INTO DATA BASE
- COMPUTERIZE A LISTING OF DATA ACQUISITION SENSORS AND INSTRUMENTATION USING NASA INPUT

# DATA FLOW DIAGRAM



## TASK 2 OBJECTIVES

- DEVELOP TOTAL ENERGY SLIDE PACKAGE
- DEVELOP SOLAR ENERGY SLIDE DEPOSITORY AND CATALOG
- DEVELOP MSFC SOLAR ENERGY EFFORT SPEECH MODULES
- SET UP SOLAR ENERGY INFORMATION ROOM
- SURVEY MSFC SOLAR ENERGY CONTROL ROOM

## TASK 2 ACCOMPLISHMENTS

- DEVELOPED TOTAL ENERGY SLIDE PACKAGE AND NARRATION
- CONTINUING TO UPDATE AND REFINE SOLAR ENERGY SLIDE DEPOSITORY AND CATALOG - 3 SETS
  - ADDING NEW SLIDES AS AVAILABLE
  - REPLACING OR PURGING OBSOLETE SLIDES
  - REFINING AND EXPANDING CATALOG
- CONTINUING SLIDE MODULES ON MSFC SOLAR ENERGY EFFORT
  - CAPTIONS AND BRIEF EXPLANATION OF SLIDES
  - ORGANIZE SLIDES INTO SUBJECT MATTER MODULES
- DEVELOPED SOLAR ENERGY INFORMATION ROOM
  - SLIDE VIEWERS DELIVERED
  - PACKAGES OF INFORMATION FOR REQUESTERS
- SURVEYED MSFC SOLAR ENERGY CONTROL ROOM AND PUBLISHED REPORT ON ANALYSIS AND RECOMMENDATIONS
- DEVELOPED AND DELIVERED SOLAR ENERGY WATER HEATING DEMONSTRATION UNIT - ON-GOING

## TASK 2 RECOMMENDATIONS

- SURVEY MSFC TASK TEAM AND THEIR IDEAS AND NEEDS IN PUBLIC INFORMATION AND EDUCATION AREAS
  - REDIRECT SLIDE COLLECTION AND CATALOGING EFFORT TO SURVEY GUIDELINES
  - PURGE SLIDE DEPOSITORY BASED ON SURVEY GUIDELINES
  - DETERMINE DEMO UNITS NEEDED AND DEVELOP AS REQUIRED
- DEVELOP USER'S BROCHURE FOR SLIDE DEPOSITORY
- CONTINUE TO UPDATE, CAPTION, AND WRITE EXPLANATION OF EACH SLIDE
- DEVELOP TAILORED INFORMATION PACKAGES BY SUBJECT MATTER
  - SLIDES WITH BRIEF WORDS
  - MAILOUT PACKAGES
- CONTINUE TO DEVELOP IMPROVED SOLAR HOT WATER DEMONSTRATION UNITS

### **TASK 3 OBJECTIVES**

- **PREPARE LISTING OF ALL AVAILABLE SOLAR RADIATION MEASURING EQUIPMENT**
- **PREPARE TECHNICAL DATA SHEET FOR EQUIPMENT CHARACTERISTICS**



### TASK 3 ACCOMPLISHMENTS

- PREPARED PRELIMINARY EQUIPMENT LISTING FOR NATIONAL SOLAR ENERGY WORKSHOP
- CONTACTED EQUIPMENT MANUFACTURERS
- RECEIVED REPLIES FROM ALL 38 INQUIRIES
- TOTAL OF 141 INSTRUMENTS INCLUDED IN LISTING
- INCLUDED COST CODES, GLOSSARY, AND MATRIX IN REPORT

### TASK 3 RECOMMENDATIONS

- COPIES BE DISTRIBUTED TO MANUFACTURERS AND DEALERS LISTED
- NEW FORMAT BE ADOPTED AS STANDARD TO DESCRIBE SOLAR RADIATION  
MEASURING EQUIPMENT
- INCLUDE THIS INFORMATION IN THE TECHNICAL DATA BASE (TASK 1)

#### TASK 4 OBJECTIVES

- IDENTIFY SOLAR RADIATION DATA NOT ARCHIVED  
BY THE NATIONAL WEATHER SERVICE
- COORDINATE WITH MSFC-ERDA-NOAA FOR A PLAN TO  
EVALUATE AND USE THE DATA

#### TASK 4 ACCOMPLISHMENTS

- PRELIMINARY LIST OF NWS AND OTHER DATA  
WAS PUBLISHED IN MAY 1976
- COORDINATION MEETING WITH ERDA-NOAA-MSFC-UAH  
JULY 1976. REPORT INCLUDES PLAN FOR USE OF  
SELECTED DATA.
- REVISED LIST OF NWS AND OTHER DATA PREPARED  
FOR PUBLICATION SEPTEMBER 1976

#### TASK 4 RECOMMENDATIONS

- CONTINUE LISTING NEW SOLAR RADIATION DATA SOURCES
- WITH NOAA AND ERDA SELECT AND EVALUATE DATA FOR USE  
IN SOLAR RADIATION PROJECTS
- PUBLISH USEFUL SOLAR RADIATION DATA
- INCORPORATE DATA INTO MSFC DATA BASE AS IT BECOMES  
AVAILABLE (TASK 1)

## TASK 5 OBJECTIVES

- COORDINATE SUBCONTRACT ACTIVITIES OF THE ASHRAE  
IN SUPPORT OF MSFC DESIGN REVIEW FOR COMMERCIAL  
DEMONSTRATION PROGRAM
- COORDINATION OF WORKSHOPS AND/OR SYMPOSIUMS FOR  
TECHNICAL INFORMATION TRANSFER
- PROVIDE SUI , FOR DEVELOPMENT OF TECHNICAL AND  
EDUCATIONAL MATERIALS (WORKSHOPS, SEMINARS, ETC.)

## TASK 5 ACCOMPLISHMENTS

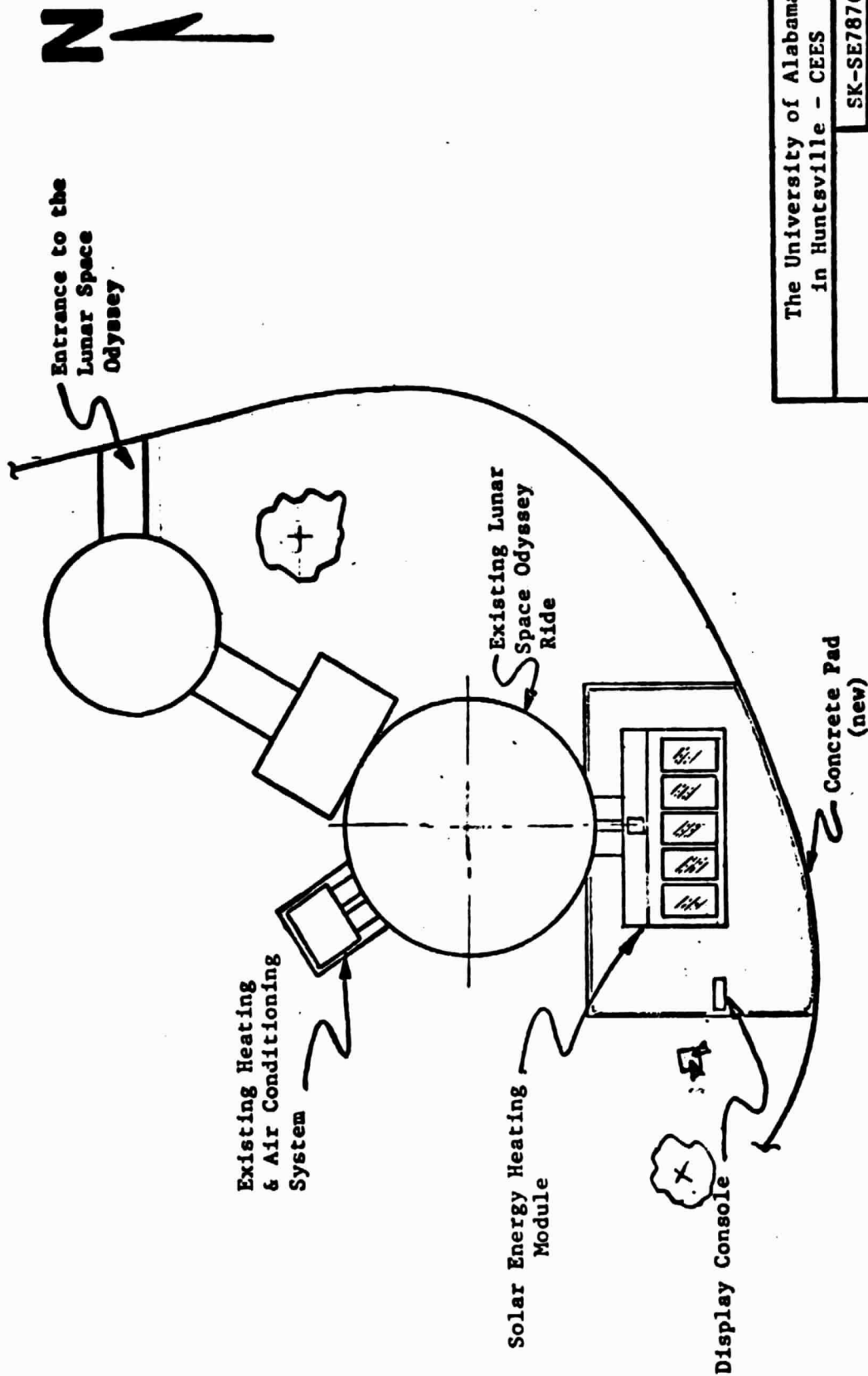
- DESIGN REVIEWS ACCOMPLISHED
  - ALABAMA POWER COMPANY
  - FRENCHMANS REEF MOTEL (VIRGIN ISLANDS)
  - REEDY CREEK UTILITIES DIVISION (DISNEY WORLD)
  
- COORDINATED MEETING ON 20 AUGUST BETWEEN ASHRAE,  
UAH AND MSFC FOR DEVELOPMENT OF PROJECT EVALUATION  
METHOD

## TASK 5 RECOMMENDATIONS

- LONGER LEAD TIME FOR DESIGN REVIEW  
EFFORTS PERFORMED BY ASHRAE
- CLOSER LIAISON BETWEEN UAH AND MSFC
- FORMALIZE UAH-ASHRAE EFFORT (TASK 5 EXPANSION)  
FOR PROJECT EVALUATION METHOD



# PROPOSED SITE FOR UAH SOLAR ENERGY HEATING MODULE



The University of Alabama  
in Huntsville - CEES

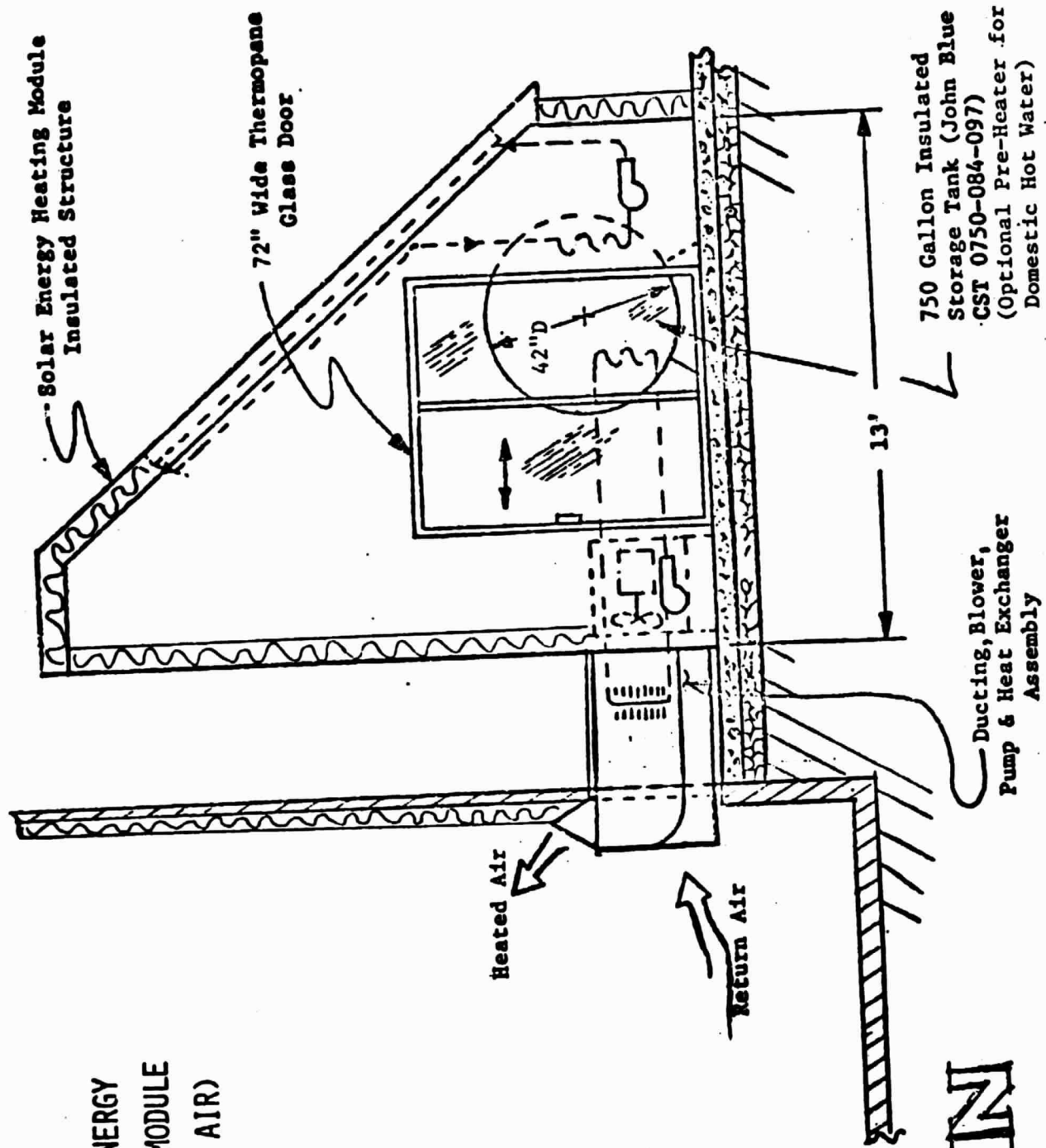
SK-SE7876

Plan View of Solar Energy Heating  
Installation - Alabama Space &  
Rocket Center

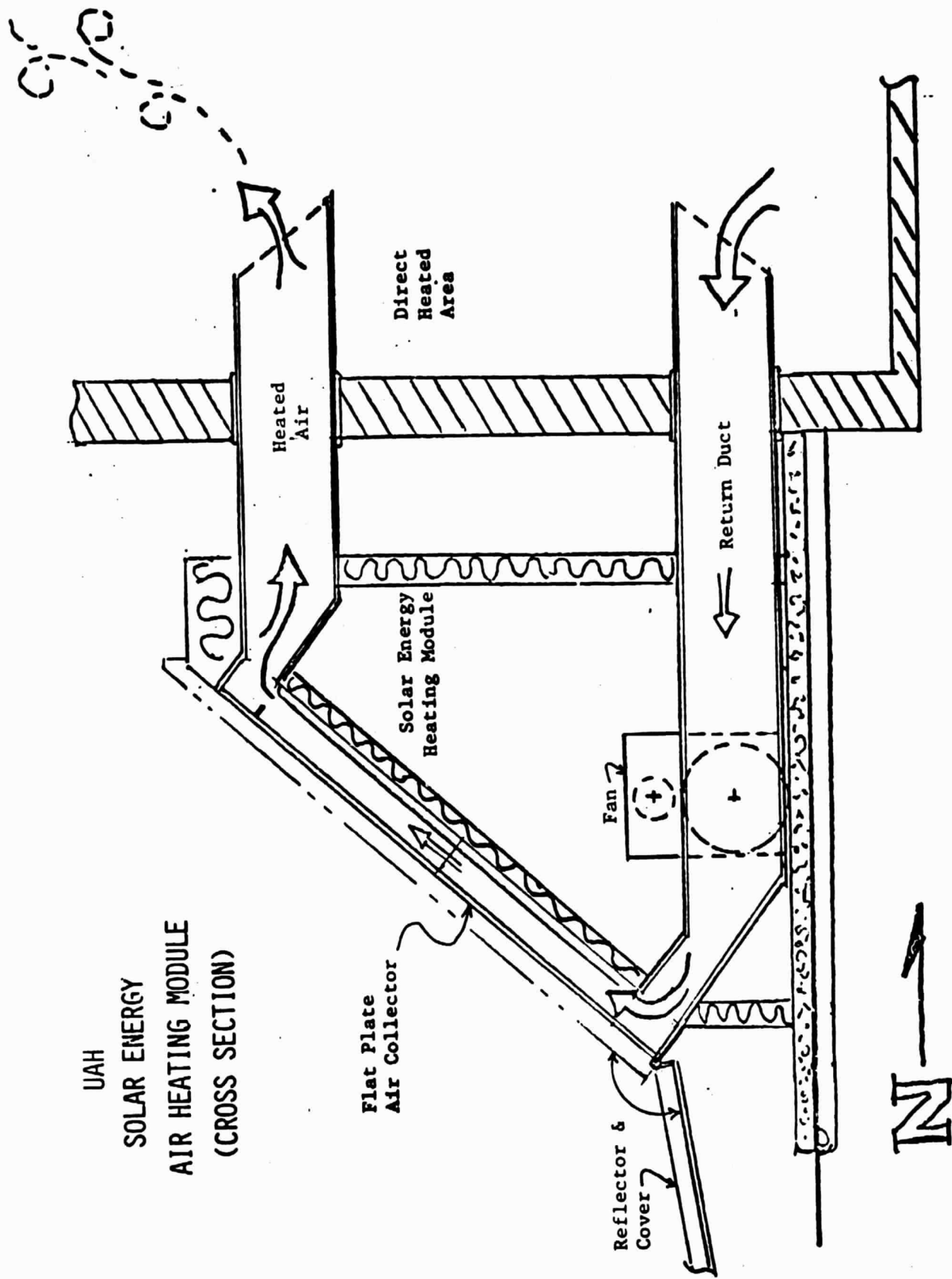
Dwg: H. Steelman Date: 7/8/76  
App: D. Christensen

22

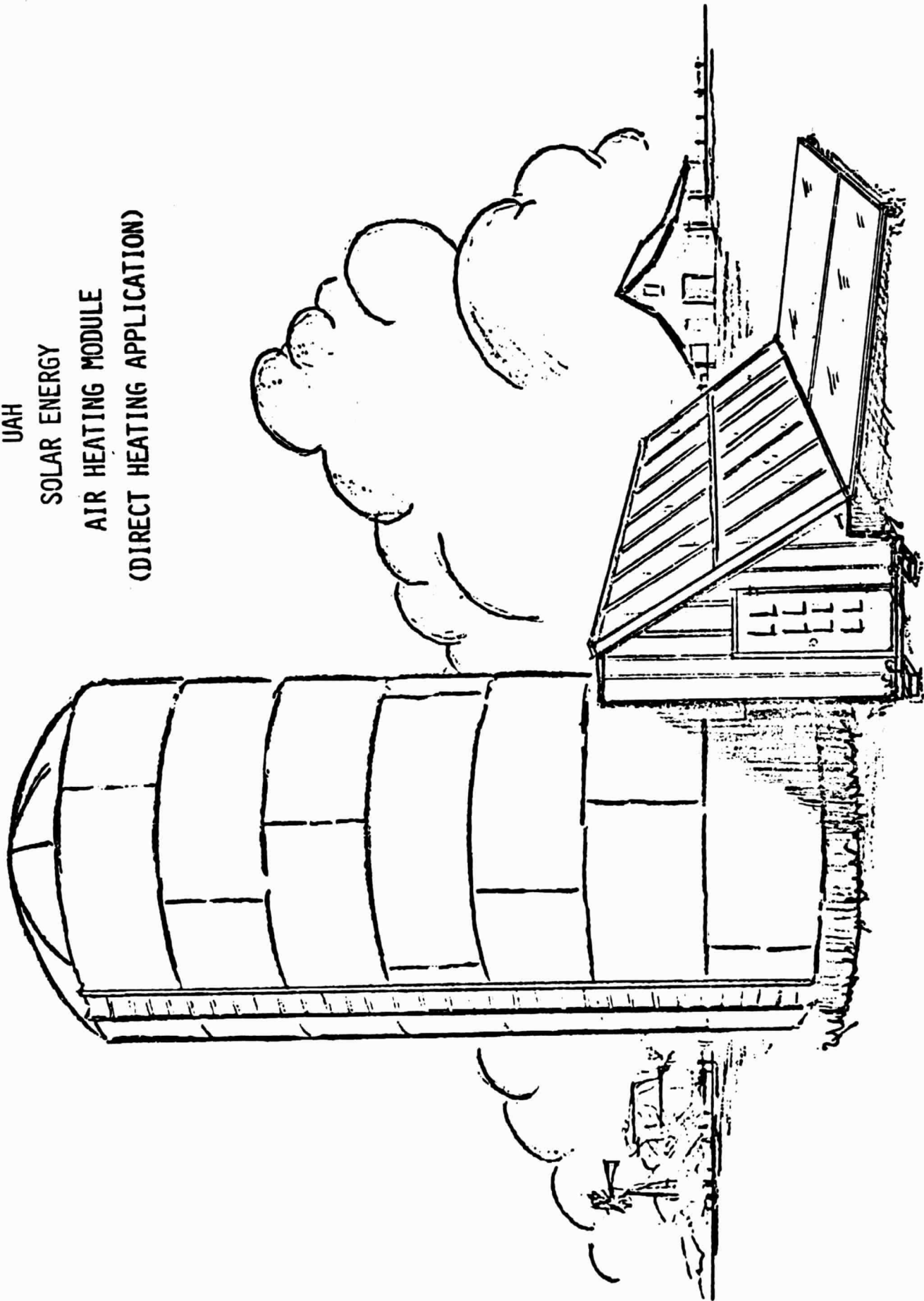
UAH  
SOLAR ENERGY  
HEATING MODULE  
(WATER & AIR)



UAH  
SOLAR ENERGY  
AIR HEATING MODULE  
(CROSS SECTION)



UAH  
SOLAR ENERGY  
AIR HEATING MODULE  
(DIRECT HEATING APPLICATION)



USER REQUIREMENTS FOR DATA AND INFORMATION MANAGEMENT

USER REQUIREMENTS DEFINITION

CLASSIFICATIONS AND LOCATION

POTENTIAL INTERESTS AND NEEDS (SURVEY)

DATA VOLUME REQUIREMENTS

INTERFACE REQUIREMENTS

COSTS AND BENEFITS

ANALYTICAL TECHNIQUES

QUESTIONNAIRE DEVELOPMENT

USER CONTACTS

CATEGORIZATION

DATA SOURCES AND AVAILABILITY

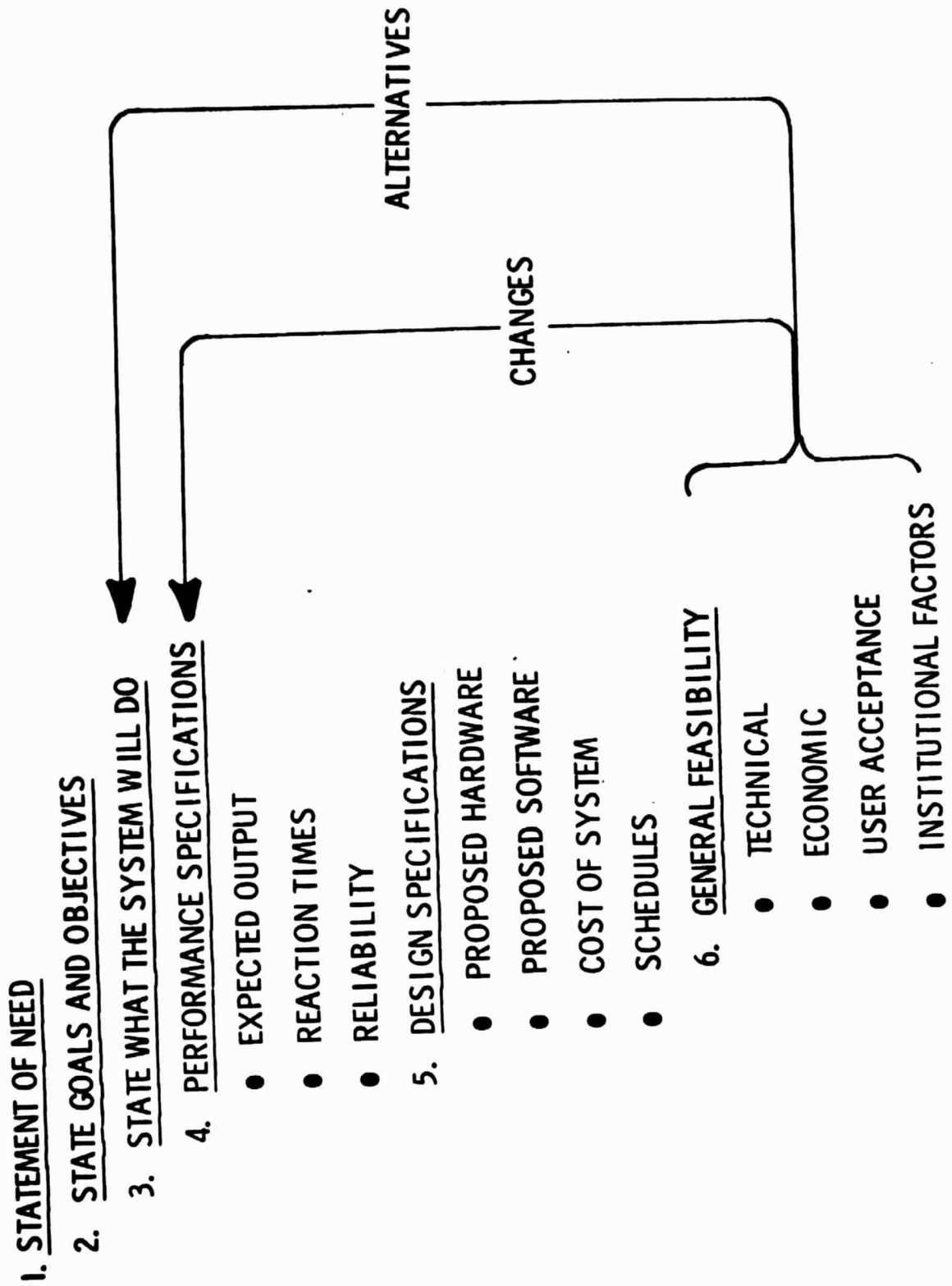
APPLICATION

COMPUTER DATA BASE

HARD COPY REQUIREMENTS

STORAGE AND RETRIEVAL TECHNIQUES

## SYSTEMS DEVELOPMENT PROCEDURE



**MANAGEMENT INFORMATION SYSTEM (MIS)  
REQUIREMENTS**

- **RAPID DATA REDUCTION AND DISSEMINATION**
- **APPLICATION OF FUNDS AND EXPERTISE WHERE LOW RISK/HIGH  
RETURN RESEARCH WILL HAVE A LARGE EFFECT ON THE STATE-OF-  
THE-ART**
- **IDENTIFICATION OF PROGRAM MANAGEMENT NEEDS**
- **DEFINE OVERALL SYSTEMS CRITERIA**
- **STANDARDIZATION OF TERMS, FORMATS, DEFINITIONS, ETC.**

## MIS TASK-APPROACH

- REVIEW AVAILABLE SOLAR ENERGY PROGRAM MANAGEMENT PARAMETERS
- COMPILE DETAILED LIST OF ALL DATA REQUIRED TO MANAGE SOLAR ENERGY PROGRAMS
- DETERMINE APPLICATION OF DATA THAT CAN BE DISPLAYED, DISSEMINATED AND UTILIZED BY PROGRAM MANAGEMENT
- DETERMINE RELATIONSHIPS FOR USABLE DATA TO MEET PROGRAM MANAGEMENT OBJECTIVES:
  - SYSTEM FEASIBILITY DEMONSTRATION
  - DETERMINE AREAS WHERE PROGRAM WILL BE MOST EFFECTIVE IN MEETING DEMONSTRATION OBJECTIVES
  - IDENTIFY PROGRAM BENEFITS AND GIVE THEM VISIBILITY



## MIS TASK-OUTPUT

- REVIEW AND RECOMMENDATIONS FOR MEETING PROGRAM MIS REQUIREMENTS
- A SET OF DEFINITIONS FOR QUALITATIVE TERMS
- SUGGESTED DATA REQUIREMENTS IN MATRIX FORM
- MATRIX FORMATS AND/OR COORDINATES FOR CURVES THAT CAN BE USED FOR DATA DISPLAYS
- SELECTION OF DATA THAT CAN BE USED TO RAPIDLY MEASURE PROGRESS AND EFFECTIVENESS OF THE PROGRAM
- PROGRAM IMPLEMENTATION PROCEDURES

## SUMMARY

UAH NOW HEAVILY INVOLVED IN SOLAR ENERGY PROGRAM ACTIVITIES  
IN SUPPORT OF MSFC:

- COMPUTERIZED DATA BASE (MIRADS)
- MANAGEMENT AND EDUCATIONAL MATERIALS DEVELOPMENT
- SOLAR RADIATION INSTRUMENT CATALOG & SITE DATA  
COLLECTION
- COMMERCIAL SITE TECHNICAL REVIEWS (ASHRAE)
- DESIGN, TECHNICAL AND MANAGEMENT SUPPORT